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PHYSICS AND SLAVERY: THE RELATIVE COST OF
CALORIES FOR SLAVE INFANTS AND THEIR MOTHERS

Mark Myron Hopkins and Nicholas Scott Cardell

November 1979

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10/ Mark Myron/Hopkins and Nicholas Scott/Cardell
The Rand Corporation Harvard University

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PHYSICS AND SLAVERY: THE RELATIVE COST OF
CALORIES FOR SLAVE INFANTS AND THEIR MOTHERS¹

In Time On The Cross Robert Fogel and Stanley Engerman use as the rate of slave expropriation the percent of income produced by slaves that was not spent on their maintenance. The authors measure both income and maintenance in terms of expected present value evaluated at birth.² They calculate the value of maintenance costs for slaves of different ages from the cost of per capita slave maintenance by using "Atwater's weights."³

In their review of Time On The Cross, Paul David and Peter Temin criticize this approach. They argue that the figure derived for slave maintenance cost is too high, because the food costs per calorie for children were lower than for adults. They maintain that there is "some substantial basis for thinking that calories are provided in relatively inexpensive forms during childhood. Breast-feeding is an exemplary practice in this regard."⁴ Since the methods employed by Fogel and Engerman give more weight to children than to adults, their value for maintenance costs would be biased upward. Therefore their rate of expropriation would be too low.⁵

The example of breast-feeding is the only support that David and Temin give for their contention that the cost per calorie was less for children than for adults. But is it obvious that calories obtained by a child from mother's milk are less expensive than those obtained from ordinary adult food?⁶ Quite the contrary: A simple application of the Law of Conservation of Energy shows the invalidity of such a proposition. A calorie is a measure of the energy content of food. Breast-feeding is part of an energy transfer process, in which energy in the food eaten by the mother is transferred to the child. Hence, assuming the transfer process to be perfectly efficient, the cost per calorie for the child equals the cost per calorie for his mother. But the Second Law of Thermodynamics tells us that no energy transfer process can be perfectly efficient, and hence the cost per calorie must be greater for the suckling baby than for the mother.

To determine the actual efficiency of the transfer process, we need to look at the data. The National Academy of Sciences-National Research Council recommends that a woman producing a typical amount of milk, 850 milliliters a day, should obtain 1000 calories per day above what she normally gets.⁷ The number of calories per 100 ml. of human milk is 71.⁸ Therefore, the ratio of calories obtained by the suckling baby to the increase in calories recommended for the mother is .60. This means that the efficiency of the energy transfer mechanisms is 60 percent.

We conclude that the cost per calorie of suckling infants is greater than that of feeding adults. To the extent that this is not taken into account, Fogel and Engerman's calculations of the rate of expropriation are too high, the exact reverse of what David and Temin maintain.

FOOTNOTES

¹Part of the research for this paper was supported by National Science Foundation Grants GS-3262 and GS-27262 to Harvard University.

²Robert William Fogel and Stanley L. Engerman, Time On The Cross: Evidence and Methods--A Supplement (Boston: Little, Brown and Company, 1974) p. 124.

³Fogel and Engerman, p. 120. "Atwater's weights" are ratios of the relative number of calories needed for different ages and sexes. A table of them is given in Faith M. Williams and Carle C. Zimmerman, Studies of Family Living in the United States and Other Countries: An Analysis of Material and Method (Washington: U.S. Department of Agriculture, Miscellaneous Publication No. 223, 1935) pp. 52-3.

⁴Paul A. David and Peter Temin, "Slavery: The Progressive Institution?" The Journal of Economic History (September 1974) p. 762.

⁵David and Temin, pp. 761-762.

⁶We assume, conservatively, that the cost of calories eaten by the lactating mother is the same as for the average adult.

⁷Recommended Dietary Allowances (National Academy of Sciences-National Research Council, Publication 589, 1958) p. 5.

⁸Selma Snyderman and L. Holt, Jr., "Nutrition in Infancy and Adolescence," in Robert Goodhart and Maurice Shils, eds., Modern Nutrition in Health and Disease (Philadelphia: Lea and Febiger, 1973) p. 668. We are grateful to Nancy Chapman, R.D., of the Harvard School of Public Health for directing our attention to this source.

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